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In re Patent of :
Davis et al. :
Patent No. 6,054,038 :
Issue Date: 04/25/2000 :
Application No.: 09/093001 : DECISION
Filing or 371(c) Date: 06/08/1998 0 : ON PETITION
Title of Invention: :
PORTABLE, HAND-HELD, IN-SITU :
ELECTROCHEMICAL SENSOR FOR :
EVALUATING CORROSION AND :
ADHESION ON COATED OR UNCOATED :
METAL STRUCTURES :

This is a decision on the petition under 37 CFR § 1.378(b), to reinstate the above-identified patent, filed March 30, 2011.

The petition is **DISMISSED**.

Any further petition to revive the above-identified application must be submitted within TWO (2) MONTHS from the mail date of this decision. Extensions of time under 37 CFR 1.136(a) are permitted. The reconsideration request should include a cover letter entitled "Renewed Petition under 37 CFR 1.137." This is **not** final agency action within the meaning of 5 U.S.C. § 704.

Background

The patent issued April 25, 2000. Patentee could have paid the seven and one half (7½) year maintenance fee between April 25, 2007 and October 25, 2007, without a surcharge, or within the six (6) month grace period between October 26, 2007 and April 25, 2008. Patentee failed to do so; accordingly, the patent became expired on midnight of April 25, 2008.

The present petition

Petitioner, assignee of the present patent, files the present petition and provides that their current OP patent docketing system is fully automated, but oversight of the system is proffered by an Office Administrator. In the present case, Petitioner provides that the former Office Administrator

charged with oversight of the docketing system, and who would have received any and all maintenance fee reminders on behalf of the Assignee, was terminated for cause during the period that the present patent was to expire. Moreover, Petitioner provides that subsequent reviews by their Firm's current Office Administrator did not disclose the maintenance fee expiration, due to improper entries made by the former Office Administrator.

Petitioner provides further that in the process of a self-imposed audit of their records in March, 2011, the expiration of the patent was discovered.

Petitioner concludes that reasonable care was taken to ensure that payment of the maintenance fee would be made in a timely manner.

Applicable Law, Rules and MPEP

37 CFR 1.378(b) provides that a patent may be reinstated at any time following expiration of the patent for failure to timely pay a maintenance fee. A petition to accept late payment of a maintenance fee, where the delay was unavoidable, must include:

> (A) the required maintenance fee set forth in 37 CFR 1.20(e)-(g);
> (B) the surcharge set forth in 37 CFR 1.20(i)(1); and
> (C) a showing that the delay was unavoidable since reasonable care was taken to ensure that the maintenance fee would be paid timely and that the petition was filed promptly after the patentee was notified of, or otherwise became aware of, the expiration of the patent.

The required showing must enumerate the steps taken to ensure timely payment of the maintenance fee, the date and the manner in which patentee became aware of the expiration of the patent, and the steps taken to file the petition promptly. Furthermore, an adequate showing requires *a statement by all persons with direct knowledge of the cause of the delay*, setting forth the facts as they know them. Copies of all documentary evidence referred to in a statement should be furnished as exhibits to the statement. (Emphasis supplied).

As language in 35 U.S.C. § 41(c)(1) is identical to that in 35 U.S.C. § 133 (i.e., "unavoidable" delay), a late maintenance fee for the unavoidable delay standard is considered under the same standard for reviving an abandoned application under 35 U.S.C. § 133. *See Ray v. Lehman*, 55 F.3d 606, 608-09, 34 USPQ2d 1786, 1787 (Fed. Cir. 1995) (quoting In re Patent No. 4,409,763, 7 USPQ2d 1798, 1800 (Comm'r Pat. 1988), aff 'd sub nom. Rydeen v. Quigg, 748 F. Supp. 900, 16 USPQ2d 1876 (D.D.C. 1990), aff 'd, 937 F.2d 623 (Fed. Cir. 1991) (table), cert. denied, 502 U.S. 1075 (1992)). See MPEP § 711.03(c) for a general discussion of the "unavoidable" delay standard.

As 35 U.S.C. § 41(c) requires the payment of fees at specified intervals to maintain a patent in force, rather than some response to a specific action by the Office under 35 U.S.C. § 133, a reasonably prudent person in the exercise of due care and diligence would have taken steps to ensure the timely payment of such maintenance fees. Ray, 55 F.3d at 609, 34 USPQ2d at 1788. That is, an adequate showing that the delay in payment of the maintenance fee at issue was "unavoidable" within the meaning of 35 U.S.C. § 41(c) and 37 CFR 1.378(b)(3) requires a showing of the steps taken to ensure the timely payment of the maintenance fees for this patent.

Id. Thus, where the record fails to disclose that the patentee took reasonable steps, or discloses that the patentee took no steps, to ensure timely payment of the maintenance fee, 35 U.S.C. 41(c) and 37 CFR 1.378(b)(3) preclude acceptance of the delayed payment of the maintenance fee under 37 CFR 1.378(b).

In view of the requirement to enumerate the steps taken to ensure timely payment of the maintenance fee, the patentee's lack of knowledge of the need to pay the maintenance fee and the failure to receive the Maintenance Fee Reminder do not constitute unavoidable delay. See Patent No. 4,409,763, supra. See also Final Rule entitled "Final Rules for Patent Maintenance Fees," published in the Federal Register at 49 Fed. Reg. 34716, 34722-23 (August 31, 1984), and republished in the Official Gazette at 1046 Off. Gaz. Pat. Office 28, 34 (September 25, 1984). Under the statutes and rules, the Office has no duty to notify patentees of the requirement to pay maintenance fees or to notify patentees when the maintenance fees are due. It is solely the responsibility of the patentee to assure that the maintenance fee is timely paid to prevent expiration of the patent. The lack of knowledge of the requirement to pay a maintenance fee and the failure to receive the Maintenance Fee Reminder will not shift the burden of monitoring the time for paying a maintenance fee from the patentee to the Office. Thus, evidence that despite reasonable care on behalf of the patentee and/or the patentee's agents, and reasonable steps to ensure timely payment, the maintenance fee was unavoidably not paid, could be submitted in support of an argument that the delay in payment was unavoidable.

An error in a docketing system could possibly result in a finding that a delay in payment was unavoidable if it were shown that reasonable care was exercised in designing and operating the system and that the patentee took reasonable steps to ensure that the patent was entered into the system to ensure timely payment of the maintenance fees.

A showing of unavoidable delay will (in addition to the above) require: (1) evidence concerning the procedures in place that should have avoided the error resulting in the delay; (2) evidence concerning the training and experience of the persons responsible for the error; and (3) copies of any applicable docketing records to show that the error was in fact the cause of the delay. See MPEP § 711.03(c)(III)(C)(2).

A delay resulting from an error (e.g., a docketing error) on the part of an employee in the performance of a clerical function may provide the basis for a showing of "unavoidable" delay, provided it is shown that:

(A) the error was the cause of the delay at issue;

(B) there was in place a business routine for performing the clerical function that could reasonably be relied upon to avoid errors in its performance; and

(C) the employee was sufficiently trained and experienced with regard to the function and routine for its performance that reliance upon such employee represented the exercise of due care. See In re Egbers, 6 USPQ2d 1869, 1872 (Comm'r Pat. 1988), rev'd on other grounds sub nom., Theodor Groz & Sohne & Ernst Bechert Nadelfabrik KG v. Quigg, 10 USPQ2d 1787 (D.D.C. 1988); In re Katrapat, 6 USPQ2d 1863, 1867-68 (Comm'r Pat. 1988).

Opinion

Petitioner explains that nonpayment of the maintenance fee came about because that their current patent docketing system is fully automated, but oversight of the system is proffered by an Office Administrator. In the present case, Petitioner provides that the former Office Administrator charged with oversight of the docketing system, and who would have received any and all maintenance fee reminders on behalf of the Assignee, was terminated for cause during the period that the present patent was to expire. Moreover, Petitioner provides that subsequent reviews by their Firm's current Office Administrator did not disclose the maintenance fee expiration, due to improper entries made by the former Office Administrator.

Petitioner has not, however, explained the error, or the exact circumstances that caused the error. Petitioner only states that the former Office Administrator charged with oversight of the docketing system, and who would have received any and all maintenance fee reminders on behalf of the Assignee, was terminated for cause during the period that the present patent was to expire. Petitioner has not explained the error putatively made by the former Docket Administrator that was the cause of the delay in paying the maintenance fee. Petitioner must identify the error that was the cause of the delay.

Petitioner must also demonstrate that there was in place a business routine for performing the clerical function that could reasonably be relied upon to avoid errors in its performance

Further to this, Petitioner has not provided a statement from the former Office Administrator stating what, if any, error he/she made. As stated *supra*, an adequate showing of unavoidable delay requires a statement by all persons with direct knowledge of the cause of the delay, setting forth the facts as they know them. A statement from the former Office Administrator is required.

Moreover, petitioner has not provided any statement as to the training of the former Office Administrator that would demonstrate that reliance upon the former Office Administrator to properly perform the clerical function was reasonable. What is required is evidence of the training and supervision of the former Office Administrator during his/her employment with Petitioner, from a person with firsthand knowledge of the former Office Administrator's training and experience, i.e. the former Office Administrator's trainer/supervisor, attesting to the trasining and supervision of the former Office Administrator, such that reliance upon the former Office Administrator to perform the clerical task putatively resulting in the delayed payment of the maintenance fee, was reasonable.

Conclusion

Patentee has failed to demonstrate that the failure to pay the maintenance fee was unavoidable. The petition is dismissed.

Petitioner's current options

I. Petitioner may file a request for reconsideration.

If reconsideration of this decision is desired, a petition for reconsideration must be filed within TWO (2) MONTHS from the mail date of this decision. The petition for reconsideration should be entitled "Petition for Reconsideration under 37 CFR 1.378(b)." Any petition for

reconsideration of this decision must be accompanied by a non-refundable petition fee of $400 as set forth in 37 CFR 1.17(h).

After a decision on the petition for reconsideration, no further reconsideration or review of the matter will be undertaken by the Commissioner. Therefore, it is extremely important that petitioner supply **any** and **all** relevant information and documentation with his request for reconsideration. The Commissioner's decision will be based solely on the administrative record in existence. Petitioner should remember that it is not enough that the delay was unavoidable; petitioner must prove that the delay was unavoidable. A petition will not be granted if petitioner provides insufficient evidence to 'show' that the delay was unavoidable. Therefore, if a request for reconsideration is filed, it must establish that the entire delay in the submission of the maintenance fee was unavoidable.

II. Petitioner may request a refund of the maintenance fee and surcharge which accompanied the petition.

Petitioner may request a refund of the maintenance fee and surcharge by writing to the Office of Finance, Refund Section, Commissioner for Patents, Washington, DC, 20231. A copy of this decision should accompany petitioner's request.

Further correspondence with respect to this matter should be addressed as follows:

By mail:	Mail Stop PETITIONS Director for Patents PO Box 1450 Alexandria, VA 22313-1450
By FAX:	(571) 273-0025 Attn: Office of Petitions
By hand:	Customer Service Window Randolph Building 401 Dulany Street Alexandria, VA 22314

Telephone inquiries concerning this matter should be directed to the undersigned at (571) 272-3232.

/DLW/

Derek L. Woods
Attorney
Office of Petitions

US006054038A

United States Patent [19]

Davis et al.

[11] Patent Number: 6,054,038

[45] Date of Patent: Apr. 25, 2000

[54] **PORTABLE, HAND-HELD, IN-SITU ELECTROCHEMICAL SENSOR FOR EVALUATING CORROSION AND ADHESION ON COATED OR UNCOATED METAL STRUCTURES**

[75] Inventors: **Guy D. Davis**, Baltimore; **Chester M. Dacres**, Columbia, both of Md.

[73] Assignee: **Dacco Sci, Inc.**, Columbia, Md.

[21] Appl. No.: **09/093,001**

[22] Filed: **Jun. 8, 1998**

[51] **Int. Cl.**[7] **G01F 1/64**; G01N 17/04

[52] **U.S. Cl.** **205/776.5**; 205/777; 205/791.5; 204/404; 73/86; 324/71.2; 324/693; 324/700

[58] **Field of Search** 205/775.5, 776.5, 205/777, 791, 791.5; 204/404, 434; 324/71.2, 693, 700; 73/86

[56] **References Cited**

U.S. PATENT DOCUMENTS

4,806,849	2/1989	Kihira et al.	204/404
4,962,360	10/1990	Homma et al.	324/700
5,221,893	6/1993	Kondou et al.	324/71.2
5,426,373	6/1995	Diamond et al.	324/663
5,746,905	5/1998	Murray	205/791
5,859,537	1/1999	Davis et al.	204/404
5,896,034	4/1999	Marshall	324/700

Primary Examiner—Robert J. Warden, Sr.
Assistant Examiner—Kaj K. Olsen

[57] **ABSTRACT**

A hand-held and flexible corrosion sensor is described that uses electrochemical impedance spectroscopy (EIS, also known as AC impedance) to detect coating degradation and corrosion of coated and uncoated metals. The hand-held and flexible corrosion sensor is pressed against the surface of the structure of specimen to be inspected, and may be either straight in structural configuration in the form of a pen or bent in a curved or angled manner to achieve better access to the structure. An EIS spectrum can than be obtained in the field or under arbitrary conditions and the degree of coating or material degradation can be determined from the resultant spectrum. There are no restrictions on the configuration of the structure being inspected. The area of detection is controlled by moderating the extent and degree of wetness of the surface. A dry surface will provide a localized measurement; a wet surface will allow inspection of the wetted area.

1 Claim, 5 Drawing Sheets

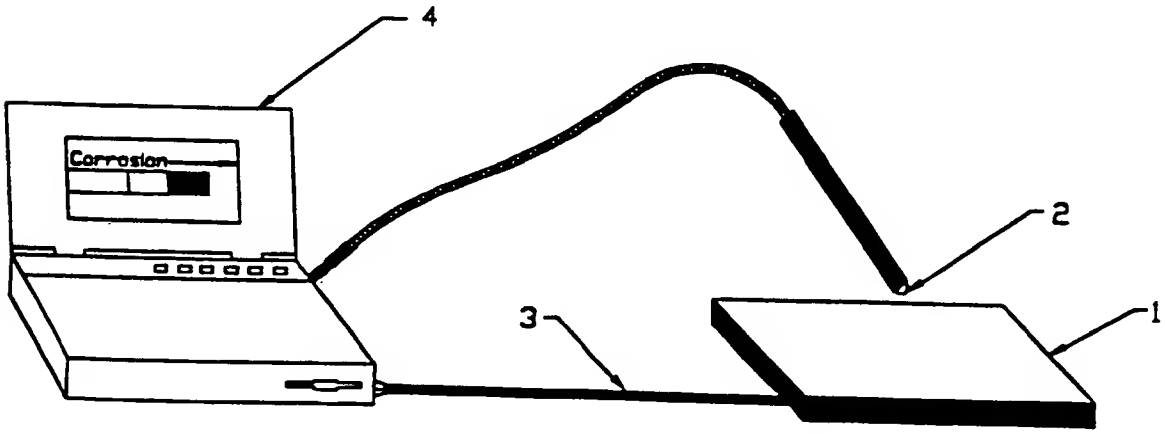


FIGURE 1

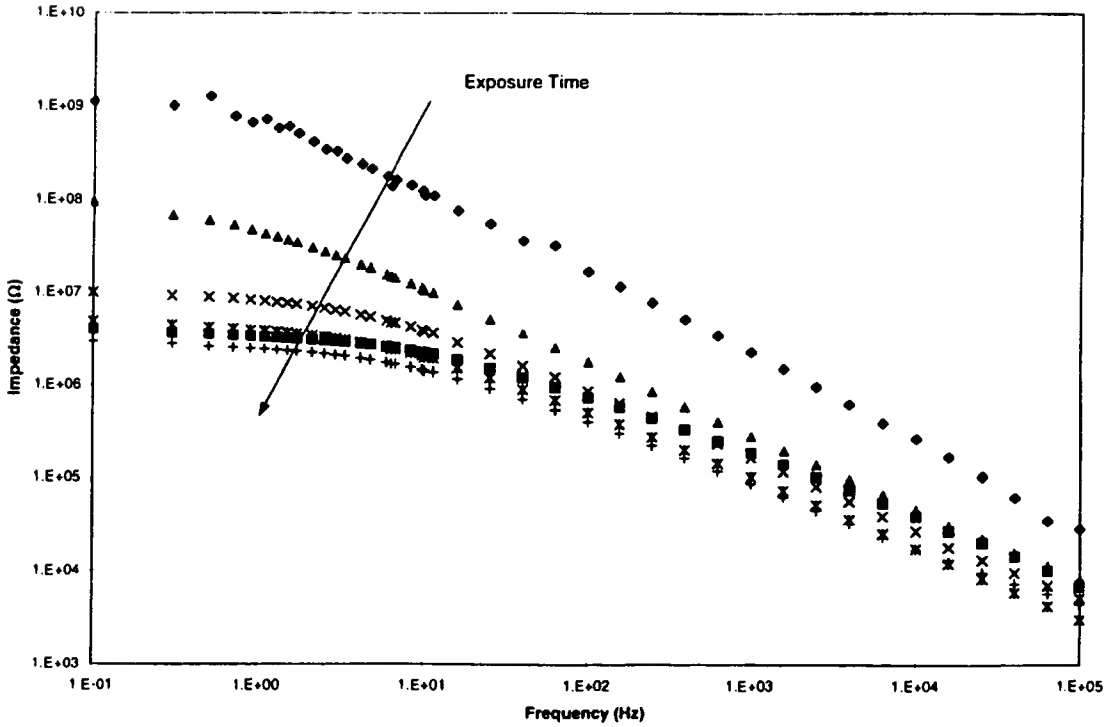

Exposure Time
Impedance (Ω)
1.E+10
1.E+09
1.E+08
1.E+07
1.E+06
1.E+05
1.E+04
1.E+03
1 E-01
1.E+00
1.E+01
1.E+02
1.E+03
1.E+04
1.E+05
Frequency (Hz)

FIGURE 2

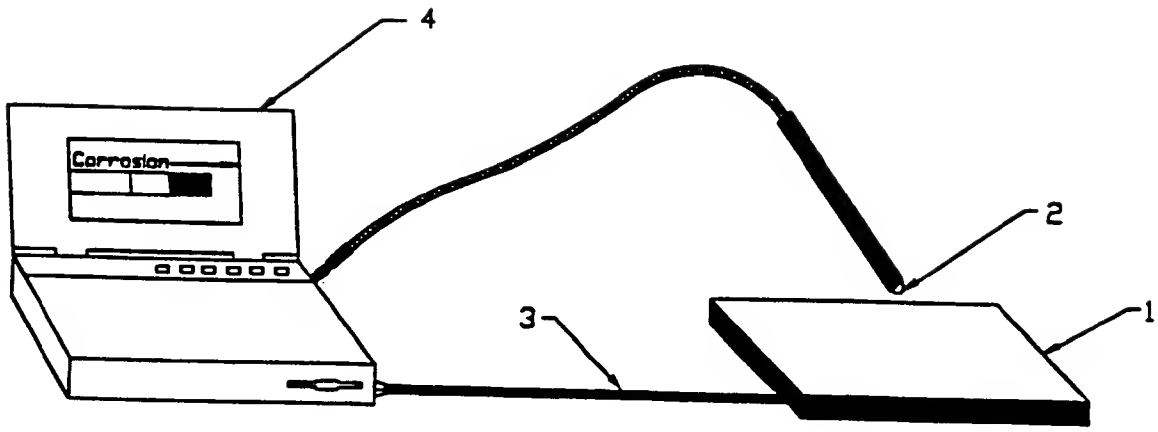


FIGURE 3

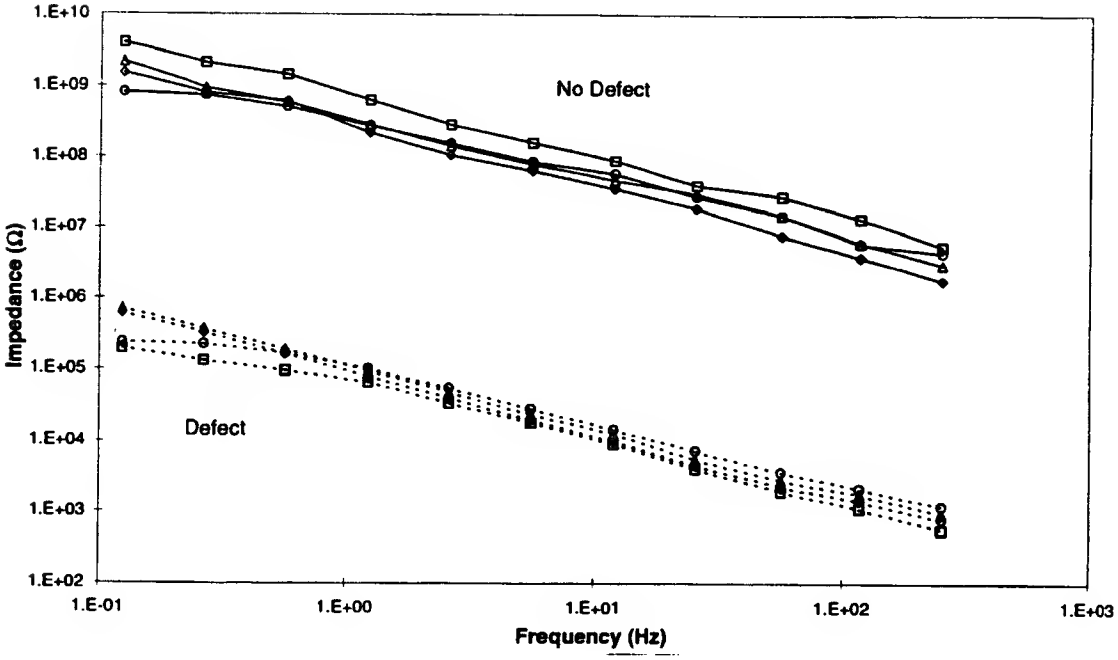

1.E+10
1.E+09
1.E+08
1.E+07
1.E+06
1.E+05
1.E+04
1.E+03
1.E+02
Impedance (Ω)
No Defect
Defect
1.E-01
1.E+00
1.E+01
1.E+02
1.E+03
Frequency (Hz)

FIGURE 4

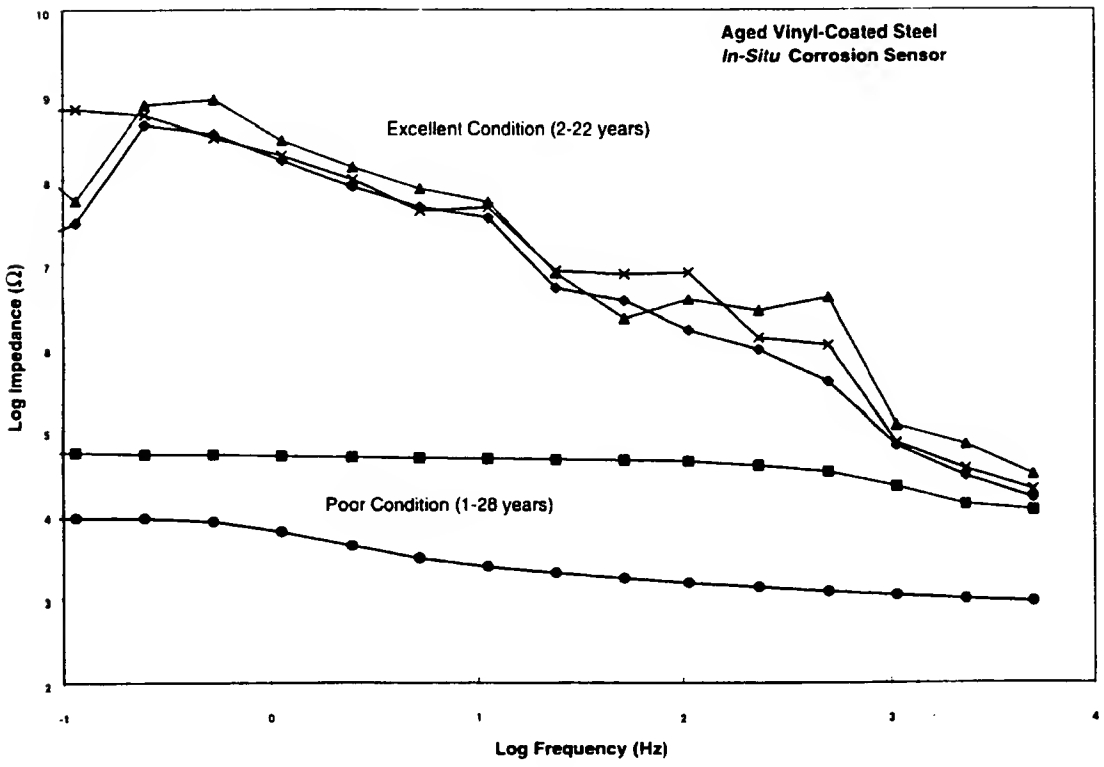
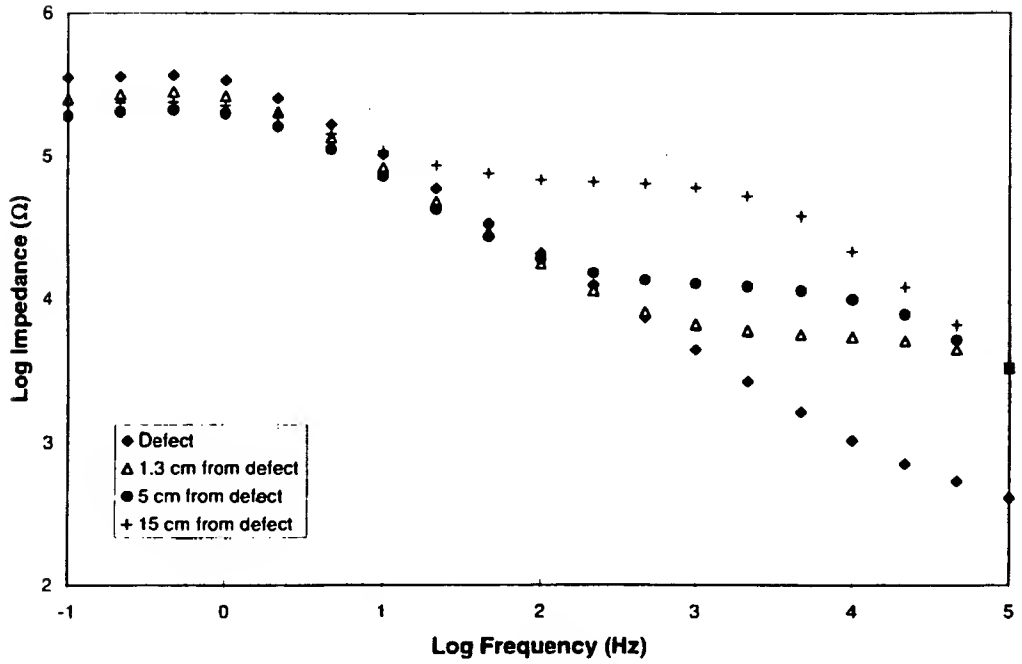

Aged Vinyl-Coated Steel
In-Situ Corrosion Sensor
Excellent Condition (2-22 years)
Poor Condition (1-28 years)
Log Impedance (Ω)
Log Frequency (Hz)
10
9
8
7
6
5
4
3
2
-1
0
1
2
3
4

FIGURE 5


Log Impedance (Ω)
Log Frequency (Hz)
6
5
4
3
2
-1
0
1
2
3
4
5
Defect
1.3 cm from defect
5 cm from defect
15 cm from defect

PORTABLE, HAND-HELD, IN-SITU ELECTROCHEMICAL SENSOR FOR EVALUATING CORROSION AND ADHESION ON COATED OR UNCOATED METAL STRUCTURES

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to a portable, hand-held and nondestructive corrosion sensing device for detecting the early stages of metal and coating degradation and electrochemical corrosion. More specifically, the present invention relates to a portable corrosion sensor which is utilized under field (actual, environmental or in situ) conditions in detecting coating degradation and electrochemical corrosion of both small and large coated (painted) and uncoated metal structures, thereby permitting detection of coating and metal degradation and electrochemical corrosion well before serious deterioration of the material or structure has occurred.

2. Prior Art

A major goal in the electrochemical field has long been to create a sensor which could be utilized in field or service conditions to detect corrosion and adhesion on metal structures of any size before significant degradation has occurred. Evaluation of materials and coatings and the determination or prediction of corrosion performance of both painted and uncoated metal structures or specimens under ambient field or service conditions has traditionally involved visual comparisons which are subjective and require blistering, rusting, or other advanced stages of degradation. The use of laboratory techniques, such as electrochemical impedance spectroscopy (EIS, also known as AC impedance), which has been used to understand and predict corrosion performance during immersion exposures in different electrolytes was limited to small structures or witness specimens that could be immersed, small sections of material cut from large structures, or attachment to the structure of a clamp-on liquid cell in which a liquid or semi-liquid electrolyte and remote counter and reference electrodes were contained.

Inspection of a large structure using conventional EIS methodologies required complete immersion or use of a clamp-on cell. Such cells would be filled with a liquid or semi-liquid electrolyte (e.g., Kihira et al., U.S. Pat. No. 4,806,849; and Kazami et al., U.S. Pat. No. 4,861,453) or a spongy medium impregnated with a liquid electrolyte (e.g., Kondou et al., U.S. Pat. No. 5,221,893) with remote electrodes immersed in the electrolyte or in intimate contact with the electrolyte-impregnated sponge. These cells required an accessible, flat, smooth, and horizontal area. The set-up was considered to be time consuming and had to be performed for each measurement. Corrosion was detected only directly under the cell and use of the cell actually caused artifactual damage to the coating in many instances because of exposure to the electrolyte during measurement.

Davis et al., U.S. Pat. No. 5,859,537, recently taught a painted electrode sensor which eliminates many of the problems discussed above. The actual structure is being inspected without exposure to an extrinsic electrolyte. Measurements are possible under most natural or accelerated conditions and material and coating degradation are detectable from the very early stages. However, the Davis et al., sensor requires an electrode to be permanently painted onto the structure and is time-consuming, because of all of the fabrication steps which must be completed. It is not suitable for structures in which appearance or aerodynamics preclude an attached sensor. The sensor can induce artifactual damage in a small class of materials, primarily porous coatings.

Presently, there is no portable, hand-held corrosion sensing device for early detection of electrochemical corrosion, metal and coating degradation which can evaluate degradation on structures or material of any size, under in situ or actual conditions, as well as under aggressive corrosive conditions, and which requires no permanent attachment.

SUMMARY OF THE INVENTION

The principal objective of the present invention is to provide a portable, hand-held and nondestructive corrosion sensing device which is utilized under field (actual, environmental or in situ) conditions in detecting coating degradation and electrochemical corrosion of both small and large coated (painted) and uncoated metal structures, thereby permitting detection of coating and metal degradation and electrochemical corrosion well before serious deterioration of the material or structure has occurred. The present invention allows for broad applicability, flexibility in utilizing the sensor in various environments without structural compromise and/or the ability to inspect and evaluate corrosion of the actual structure, regardless of the size of the structure.

The foregoing objectives can be accomplished utilizing the present invention as a portable, hand-held and nondestructive corrosion sensing device providing an in situ sensor for producing an output correlative to an identifiable impedance spectrum (i.e., the impedance magnitude and phase as a function of the frequency of the applied voltage, created utilizing AC Impedance or Electrochemical Impedance Spectroscopy (EIS). The preferred embodiment of the invention is a portable, hand-held and nondestructive apparatus, comprising a pen-like device which consists of a metal tip which serves both as a counter and reference electrode. The metal structure being tested, which either may be coated or uncoated, serves as the working electrode. This two electrode sensing device measures differences in impedance spectra which are responsive to atmospheric, water uptake, incubation, and corrosion; utilizing, the metal tip as the counter and reference electrode, applying a small electrical voltage between the metallic substrate of the structure, which serves as the working electrode, and the counter/reference electrode and measuring the resulting current based upon the applied voltage between the electrodes. The portable, hand-held in situ corrosion sensor contemplated in the present invention is pressed against the top coat during inspection. The present invention readily detects the early stages of interfacial degradation well before any visual indication of corrosion appears, as well as the ability to detect, quantify and monitor coating and metal degradation from its earliest stages under both laboratory and field conditions.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is an impedance spectrum for painted aluminum following immersion for different periods of salt water exposure.

FIG. **2** is a diagrammatic representation of the pen-like sensing device with attached metal tip **2**, that serves as the counter and reference electrode. The cable which is attached to **2**, is connected to the potentiostat **4**. The working electrode **1**, is the coated metal being tested and connected to the potentiostat with an attached wire **3**.

FIG. **3** is a graphic representation of impedance spectra of epoxy-polyimide painted aluminum with and without a scratched defect using both a conventional three-electrode measurement and measurements made using three different embodiments of the present invention.

FIG. 4 is a graphic representation of vinyl-coated steel panels exposed to ambient fresh water obtained using the present invention.

FIG. 5 is impedance spectra for a painted aluminum specimen with a scratch to simulate a coating defect.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

The invention provides a portable, hand-held, in-situ electrochemical sensor capable of detecting and monitoring corrosion of an actual structure from the earliest stages of deterioration. The sensor utilizes electrochemical impedance spectroscopy (EIS) for investigating corrosion and coating degradation.

Referring to the drawings, FIG. **1** is a plot of an impedance spectrum for painted aluminum following immersion for different periods of salt water exposure. The figure shows that initially the coated metal demonstrates capacitive behavior with very high impedance at low frequencies. As the coating degrades during immersion, its resistance decreases and the impedance become independent of frequency at low frequencies.

FIG. **2** is a drawing of a portable hand-held in-situ sensor with a metal tip **2**, which acts as a reference and counter electrode. **2** is encased in a nonconductive plastic shield in the form of a pen-like holder for easy grasping in order to hold the tip of the electrode **2** onto the working painted metal **1** that is being tested. A cable is attached to the top of the pen-like electrode **2**, to facilitate an easy electrical connection to a potentiostat **4**. The working electrode **1**, has a cable attached **3**, for electrical connection to the potentiostat **4**.

FIG. **3** is a series of impedance spectra of epoxy-polyamide painted aluminum with and without a scratch defect. Each of the three variation of the hand-held probe gives results very similar to the conventional three-electrode measurements. Each measurement very clearly reflects the presence of a gross defect such as a scratch.

FIG. **4** is a series of impedance spectra of vinyl-coated steel panels exposed to ambient fresh water for excellent condition even after 22 years of exposure; others were severely deteriorated even after one year. The correlation using the portable, hand-held in-situ electrochemical sensor is excellent. The coatings that appeared in excellent condition exhibited very high impedance with predominately capacitive behavior. In contrast, those coatings that were in poor condition with numerous blisters or rusty areas had very low impedance and mostly resistive behavior.

FIG. **5** is a series of impedance spectra for a painted aluminum specimen with a scratch to simulate a coating defect. As the portable, hand-held, in-situ sensor was moved further from the defect, a plateau region at intermediate frequencies appears and corresponds to a conduction path along the surface.

We claim:

1. A method for early detection of electrochemical corrosion of a coated or an uncoated surface of a metal structure utilizing electrochemical impedance spectroscopy, comprising the steps of:

(a) providing an electrochemical impedance spectrometer, said spectrometer comprising a computer controlled potentiostat and a sensor device which comprises a metal tip, said sensor device functions as both a counter and reference electrode;

(b) placing the metal tip of the sensor device directly onto the top surface of the coated or uncoated surface of the metal structure;

(c) wetting the surface of the metal structure around the metal tip with an electrolyte, the metal tip and the area covered by the electrolyte thereby defining a controlled detection area;

(d) applying an AC voltage from the potentiostat across the metal tip and the metal structure to be tested, the metal structure thereby functioning as a working electrode;

(e) measuring the resulting AC current thus obtaining a first reading;

(f) performing steps (d) and (e) at different frequencies of AC voltage to obtain multiple readings;

(g) calculating an impedance magnitude and phase for each obtained reading, thereby generating an impedance spectrum over the entire applied frequency range;

(h) comparing the generated impedance spectrum of the controlled detection area with the impedance spectrum of previously determined measurements of metallic structures in different stages of known surface corrosion to determine the stage of surface corrosion of the metal structure being tested.

* * * * *